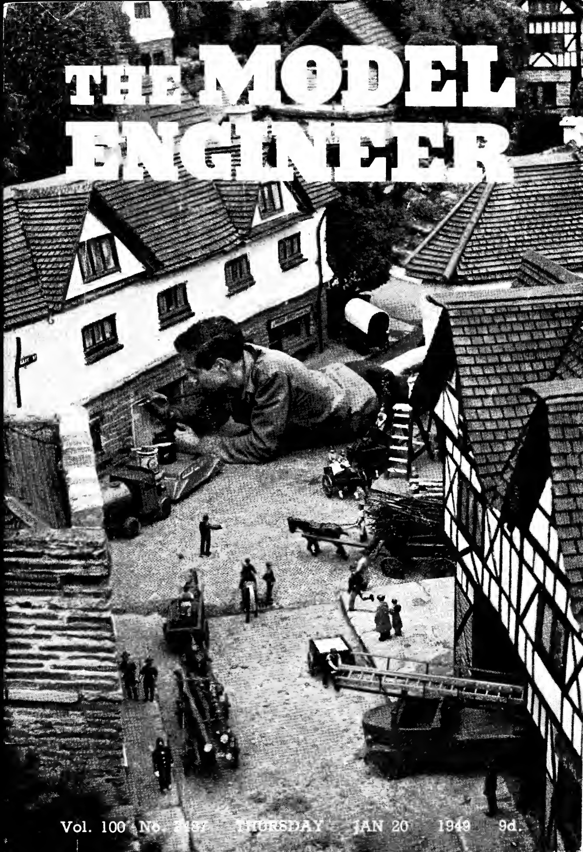
THE MODEL ENGINEER



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The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

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SMOKE RINGS

Our Cover Picture

● THE POPULAR model village of Bekonscot provides the scene from which this week's cover picture is taken. During the winter months, the little village undergoes a certain amount of renovation and re-painting to make it ready for summer visitors. The re-painting process provides some novel situations for the painters, one of whom is seen at work while some of the Lilliputian inhabitants look on, with evident interest.

A Grievous Accident

● THE NEWSPAPERS recently reported the case of a young man who was flying a model aeroplane tethered to a steel wire. He was out in open country across which, however, a high-voltage electric supply cable, of a type now common in all parts of the country, was suspended. Unfortunately, the 'plane came into contact with the cable, with the result that the young man received an electric shock which killed him instantly. We believe this is the first accident of its kind, but it should serve as a warning to control-line flying enthusiasts, and even kite-flyers should be careful to avoid contact with these cables. In a damp atmosphere a fatal shock could be transmitted through ordinary string.

Model Engineering in the Future

● ONE OF our readers, reflecting on the melancholy fact that the past year has seen a heavy mortality among eminent members of our fraternity, has questioned "What will happen to model engineering when the older generation has passed away?" In further comments, he expresses a somewhat pessimistic view of future prospects, but while agreeing that there must necessarily be changes, sometimes for the worse, as the old order gives place to the new, we do not consider that this inevitably entails degeneration or eventual dissolution. The idea so often expressed that skill is fast disappearing is certainly not borne out by the steady improvement in the quality of models, as exemplified by the work displayed in various exhibitions and the "M.E." Exhibition in particular. Though the older generation of enthusiasts may deplore the apparent falling off in aesthetic standards in the choice of subjects for modelling, this is in fact but a reflection of the tendencies in full-size engineering, where utility and production requirements must necessarily be given precedence over appearance. There is certainly no falling off in enthusiasm for model engineering, and some of the work executed by the younger workers shows considerable promise. Only one tendency in

model engineering gives us any misgivings at present; that is, the passion among some of the rising generation for obtaining quick and spectacular results, and for limelight and kudos, rather than the steady effort, and "art for art's sake" which exemplified the worker of the past; but we hope and trust that this is but a passing phase, arising out of the generally unsettled state of everyday life, and that with more mature experience will come a keen appreciation of the creative and recreative value of the actual work of the model engineer, as distinct from disregarding everything but the ultimate results achieved.

A Roll-top Workshop

MR. W. V. KETHRO, of Bristol, has sent us a photograph of an unconventional sort of workshop. It was designed for work in a more sociable atmosphere than a full-grown workshop, and closes down completely when it is not in use; only the treadle is then visible.

The lathe is a Wolf-Jahn with cross-slide and vertical slide, lever tailstock and various home-made accessories. The sensitive drill was built up from scrap material and has to be dismounted before the desk can be closed; it is motor-driven. The lamp folds down and the vice swivels out of the way. The large models were made on a Drummond 4-in. lathe, while the two small unfinished locomotives were made on the desk; they are for $\frac{3}{8}$-in. gauge two-rail electric operation.

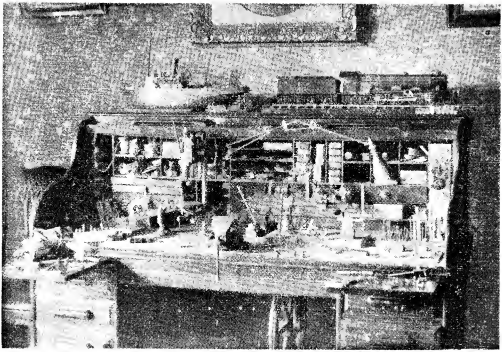
We have illustrated "furniture" workshops, from time to time, in the past, but we do not recall a previous example quite like Mr. Kethro's ingenious arrangement. He has certainly struck a most admirable balance between a thoroughly utilitarian device and a good-looking piece of furniture.

S.M.E.E. Officers

MR. D. H. HARRIS has succeeded Mr. A. J. R. Lamb as the Hon. Treasurer of the S.M.E.E. Other changes include the election of Mr. A. B. Storrar as Hon. Secretary in place of Mr. E. L. Ashton who has retired; the Chairman for this year is Mr. D. H. Chaddock, in succession to Mr. J. Latta. It is good to notice that all the gentlemen mentioned are well known, by name at least, to our readers, and we offer them our congratulations and best wishes in their new appointments. We feel that the link between the society and THE MODEL ENGINEER is as strong as ever.

Sir Malcolm Campbell

THE RECENT death of Sir Malcolm Campbell has removed one of the outstanding personalities from the field of motor and speed boat racing. His persistent attacks over many years on speed records have thrilled specialists and the general public alike. Not so well known, perhaps, was his interest in models, and he had, we believe, an interesting collection of models of his own "Bluebird" cars and power boats. He was president of the Sutton Model Engineering Club and often entered enthusiastically into the club's activities.

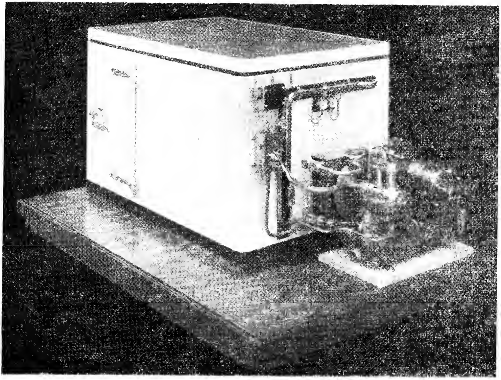


Mr. W. V. Kethro's roll-top workshop and some of his models

Refrigeration in Miniature

by J. McCreesh

REFRIGERATING machinery is one of the most unobserved and undiscussed pieces of mechanism there is, although there are thousands of them, large and small, in every town and country. The actual way in which it works remains a complete mystery to the average person, and I think it is for this reason that as far as I



General view of plant and cold room

am aware one has never been modelled. It is with this in mind that I claim, if not to be the first to have made a complete working model commercial-type refrigerator, to have made the smallest.

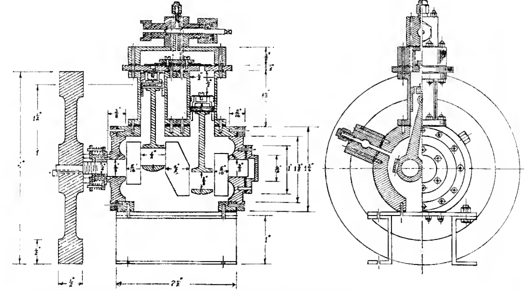
I am not including domestic types, because although some very small-capacity cabinets of the absorption type have been made, these, of course, are not mechanical. By trade I am a refrigeration installation and service engineer. This was a very big asset and my practical knowledge was half the battle in the construction of the model, and it will be appreciated that I had the advantage over anyone else not in the trade who may have thought of building one.

Automatic electric refrigerators can be, through no apparent mechanical fault, the most troublesome pieces of machinery on earth, as any reader who possesses one will probably have found out. I have had troubles and trials on some of my jobs, but in my effort to get it in proper working order, this model was the cause of my biggest headaches.

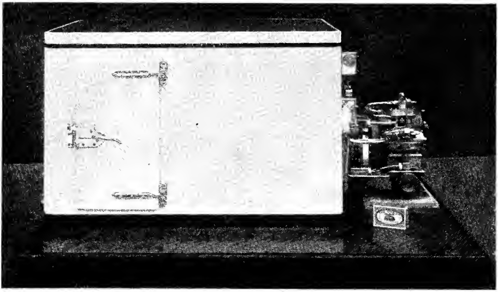
Apart from this, I have had very little experience on the lathe ; in fact, I have never made any more than a plain bearing bush, and this was getting a bit uninteresting, seeing that I had at my disposal a $3\frac{1}{2}$-in. Myford screw-cutting lathe. Having a little time on my hands, therefore, and without the mere thought of a complete finished model ever entering my head, I picked up a length of round mild-steel and decided to try and turn up a small double-throw crankshaft similar to the crankshafts used in my firm's compressors. This was carefully marked out and centred without such luxuries as vee-blocks and scribing-blocks, etc. ; there followed many, many laborious but happy hours with a parting tool and at last my efforts were rewarded with

what was to me a beautiful piece of work. As I have already said, I had nothing further in mind when I started, but I was so delighted with my product that I decided to make the complete compressor. This, again, was going to be the end, but, alas, this model engineering had got me with a firm grip, and, needless to say, my domestic duties were being sorely neglected. However, after twelve months of odd evenings and week-ends, a complete condensing unit found its way to the 1947 MODEL ENGINEER Exhibition.

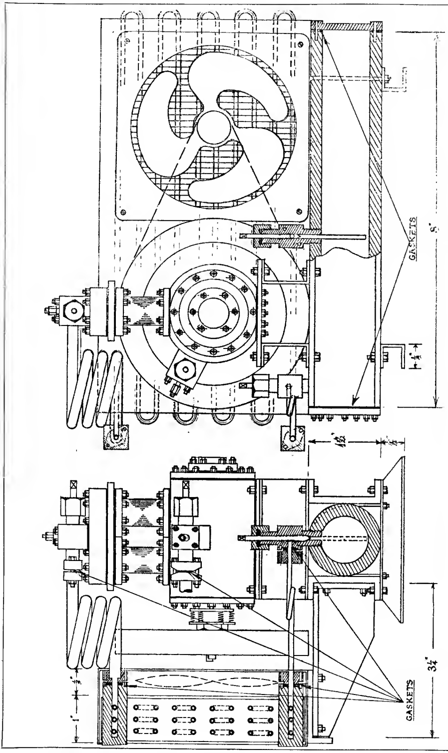
At that show I was given the greatest encouragement, and I carried on and made an evaporator coil and expansion valve. I was in doubt as to whether the outfit would work, owing to its very small dimensions and I decided that if it was a success, I would build a cold room for it. Well, the finished article is proof. To me that little crankshaft holds the most sentimental value, because it is the centre upon which everything was built, and has taught me a lot about lathe work.



Sectional views of the compressor



Front view, with matchbox for comparison. Note double-action door fastener

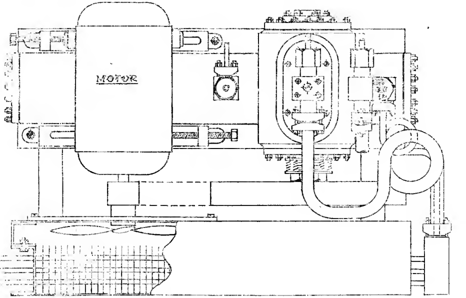


End and front views of the unit, showing fan, part section of condenser and receiver

No drawings of any description were made during the building of this machine, and the sketches on these pages which I have since drawn are as near a true copy of the job as I can possibly remember.

The condensing unit is made as near as possible to the type usually found operating any commercial refrigerator, although it is not a model of 1/64 in. thick sheet alloy. The end-bearings of the compressor are also made of phosphor bronze.

The crankshaft was turned up from mild-steel bar having $\frac{3}{8}$-in. journals on mains and cranks by $\frac{1}{2}$-in. stroke. Connecting-rods were marked up from $\frac{3}{4}$-in. square brass with split big-ends and $\frac{1}{8}$-in. bore small-ends, gudgeon pins are silver-steel hollow, with brass thrust



Plan view of condenser

any particular make. It has one or two features, perhaps not visible, of a certain manufacture. The refrigerant used is methyl chloride, approximately 4 oz. The compressor is of the usual twin-cylinder reciprocating type, having a stroke of $\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. bore and driven by a 230 volt a.c./d.c. motor of approximately 1/20 h.p. Both are mounted on a frame built up of hefty proportional channel section.

The compressor crankcase was turned up from a piece of phosphor bronze bearing metal, and faced off top and bottom to take cylinders and baseplate. All the stud holes in this part of the compressor are blind holes and extreme care had to be taken not to go right through when drilling, otherwise, this being part of the gas charged system and likely to have a pressure of up to 100 lb. per sq. in., leaks would occur along the stud threads. Unlike steam engines where extra steam can be obtained, refrigerators are charged with a predetermined amount of liquid refrigerant, no less and no more; therefore, the slightest leak which is not in most cases visible or audible will upset the whole system, and the result in the end is no refrigeration. That is the reason why I have such a lot of 8-B.A. studs and nuts holding all joint faces together. All these faces are fitted with gaskets with pads in each end. The pistons, which are $\frac{1}{2}$ in. bore $\times$ $\frac{1}{2}$ in. long, are turned up from cast-iron rod, each having two rings turned from 33/64-in. silver-steel and split with a small saw. Unfortunately, a lot of compression is being lost through these but I can think of no other substitute for piston-rings except graphite string, and this is out of the question because the circulating methyl chloride would chase the graphite round the system and cause blockages and no end of trouble. Refrigeration systems, as well as being gas-tight, must be absolutely free from all foreign matter and also moisture, the latter being one of the biggest enemies. The two cylinders were turned from mild-steel and lapped to mirror finish.

The piston heads, which are lapped dead flat, have four small holes drilled through; these are covered by flat steel discs located by a small 8-B.A. cheese-head screw and allowed a very slight lift, to enable the gas to come through on the downward stroke and be compressed in the upward stroke. The valve-plate between the cylinders and compressor head is fitted with a reed or flapper-valve covering two ports in the lapped surface of the plate, this being a non-return valve for the compressed gas.

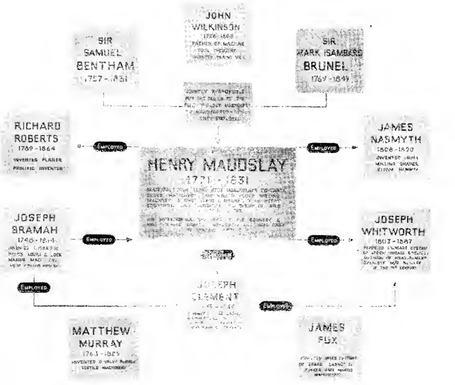
(To be continued)

The Early History of Machine Tools

AMONG the numerous items of interest at the Machine Tool and Engineering Exhibition held last September, few attracted more general attention than the Historical Exhibit of the Machine Tool Trades Association. In contrast to the profusion of highly developed modern machine tools displayed on all the other stands, this exhibit went right back to the roots of the machine tool industry, and demonstrated in a striking manner the basic prototypes from which all engineering production machinery has been evolved, featuring in most cases either the actual tools or accurate models of them.

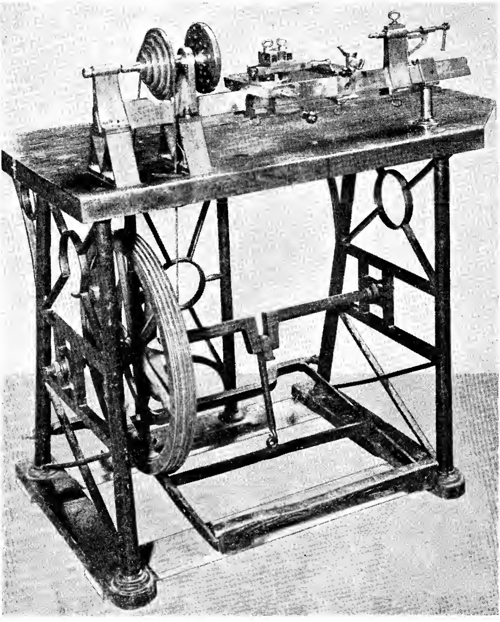
To model engineers, who are perhaps in closer touch with first principles of machine tool design than the users of highly elaborate special-purpose machines, these examples of early design present not only an absorbing interest, but also an object lesson in the surmounting of obstacles and limitations in material and equipment, which is directly applicable to their practical problems. For this reason, we deemed it worth while to approach the Associated Machine Tool Makers Ltd., for permission to bring this exhibit to the notice of our readers; and we are pleased to say that not only has this permission been freely given, but every facility has been provided for preparing this article, including the loan of photographs and the interesting "genealogical table" which illustrates at a glance how

GENEALOGICAL TABLE OF EARLY ENGLISH MACHINE TOOL BUILDERS SHOWING THE GREAT INFLUENCE OF MAUDSLAY



the basic structure of machine tool design was built up by the efforts of the early pioneers.

Truly, the world owes much to the men who learned, and who taught others to achieve mastery over the most intractable materials, and to harness the forces of nature in the service of humanity. It is fashionable nowadays to blame the engineer and the scientist for all the ills that afflict modern civilisation, but let us not forget the other and more important side of the picture—the real benefits which industrial development, made possible only by machines and mechanical power, has brought. Nothing has contributed more to the welfare, comfort and convenience of

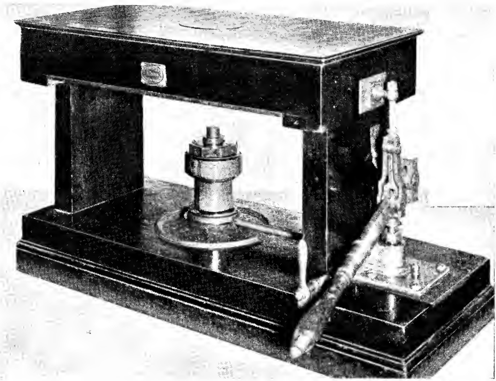


One of the earliest lathes to be fitted with a compound slide-rest and a live headstock with continuous motion from a rotary treadle gear, made by Maudslay in the early 19th century

humanity at large, than the direct or indirect products of engineering and scientific research.

There have been many definitions of the term "engineer," some witty and succinct, but most of them incomplete; one which applies very aptly to the pioneers of this profession is "a man who is never satisfied." This, of course, applies also to many other people, such as reformers and philosophers, who strove to improve the conditions or standards of life in their time; but one might be so bold as to say that the most noticeable progress has been made by the engineers, who have really got down to brass tacks and done something about it.

It is generally recognised that the modern industrial era began with the introduction of mechanical power, in the form of the steam engine, particularly that produced by James Watt, which for the first time in history gave man a practically unlimited capacity for carrying out the heaviest work. In the application of steam power, the need arose for producing and working iron and steel on a hitherto unprecedented scale, and the inadequacy of the existing tools and appliances became apparent. One of the first people to recognise this, and to seek to improve matters, was John Wilkinson, an ironmaster of Smethwick, who devised the first boring mill for the accurate internal machining of the large cylinders required for Watt's engines. The model of this mill, as displayed in the Exhibition, shows that despite its crude and primitive design, the essential requirements of the operation were truly grasped. It embodied a rigid bed or cradle on which the cylinder casting was secured by chains and wedges, and a boring-bar running in bearings at either end of the bed, with means of radial adjustment and longitudinal traverse of the cutting tool. The power was applied through toothed gears, from a waterwheel, and the model shows provision for dealing with three cylinders, on separate beds, at a time.



An early Bramah hydraulic press, with the improved ram packing devised by Maudslay

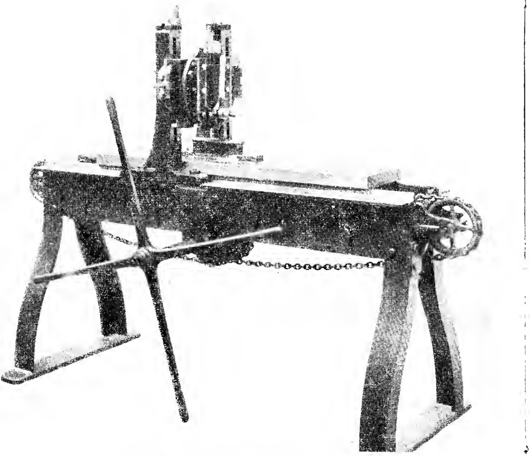
While the cylinder boring was the largest essential machining operation on a steam engine, there were numerous smaller but equally important operations calling for the use of a lathe or some comparable form of tool. The lathes in existence at the time were inefficient and by no means accurate machines, being but little removed from the ancient pole lathe, in which intermittent motion in alternate directions was obtained by a cord wound round the work, the latter being rotated between dead centres. The tools were applied by hand, and apart from the limitations in the power available to drive the work, the rate of cutting was also limited by the strength of the worker in manipulating the tools.

A very early improvement in the lathe was the introduction of the live headstock, with con-

tinuous rotary motion applied by a treadle or other source of power. But a great advance in the utility and accuracy of the lathe was made when Maudslay introduced the slide-rest, and quickly followed this up with an improvement of equally far-reaching importance, namely the screwcutting gear. Many of the features of Maudslay's early lathes have been the basis of practice which exists up to the present day; for instance, the prismatic form of bed, which combines automatic alignment with maximum resistance to torsion stress; the general design of the headstock, and the arrangement of the compound swivelling slide and tool holder.

Maudslay may be regarded as the keystone of the edifice of machine tool development; nearly all the early pioneers in this research were definitely connected with him, or with the famous engineering works which he instituted, and which lasted up to the beginning of the present century. Incidentally, it may be mentioned that THE MODEL ENGINEER can claim a direct link with the Maudslay organisation, in the person of the late Mr. Alfred W. Marshall, who was a Maudslay apprentice.

The early training of Henry Maudslay was obtained in the workshop of Joseph Bramah, famous for the invention of the hydraulic press, which although not a machine tool in the generally accepted sense of the term, is one of the most essential power appliances in modern engineering production. He also figured as a pioneer in the design of modern "burglar-proof" locks, and the machine introduced for slotting the barrels of the locks shows some most ingenious features, including indexing gear, and slides for guiding the reciprocating slotting saw, which was operated by hand. Maudslay introduced a notable improvement to Bramah's press by fitting a flexible annular ring, or "cup leather" to prevent leakage past the plunger, and this has been standard practice ever since.



The original planing machine by Richard Roberts

(To be continued)

Locomotive - Building Overseas

by "L.B.S.C."

They're on, and—they're off!

As I have not yet finished the next lot of drawings for our "serial story" locomotives—usual reason!—let us this week, by way of a change, take an imaginary trip overseas, and find out what some of our distant fraternity are doing. I don't know how many full-size steam locomotives there are in Switzerland; not many, I should imagine, because the water power in that country of mighty hills and long tunnels is so abundant, that "juice" can be generated very cheaply, and all the main lines are operated by "Milly Amp." A very fine job she makes of it, too! Much as I love steam, I freely admit that the way Milly yanks an outsize load up the grades, around the curves, through the spiral tunnels, and finally through the "big hole" of the St. Gotthard line, is beyond the capabilities of Old King Coal. Incidentally, they call the water power "white coal." Many Swiss folk have never seen a steam locomotive at all; and you can therefore easily imagine the interest aroused in a little $2\frac{1}{2}$-in. gauge "Dyak" built by a Swiss member of our locomotive brotherhood, Mr. Albert Schweizer, of Zurich.

In a cheery letter, our friend says that "railway-amateurs in Switzerland build electrified boxes"—an excellent way of putting it—in gauges "OO" and "O," and in a few instances gauge "1"; but he followed my notes in this journal, and decided to have a go at a steam locomotive, and chose the "Dyak" in $2\frac{1}{2}$-in. gauge. Being a book-keeper by profession, he had to learn how to use a lathe and tools, which he did to such good purpose that the locomotive was duly built. As it is made according to instructions, there is no need to describe it in detail; suffice it to say it performs in the manner usually observed among well-bred locomotives of this size and type, and can haul three adults or six children.

The next item was a railway for the engine to run on, and this is a continuous track with 12-metre straights, and 12-metre curves. The rails are made from 4-mm. by 10-mm. flat iron, connected by bolts, pressed into slots milled in the sleepers. The construction of the trestle carrying the line, can be seen in the pictures. The line was opened last year, in the presence of Mr. George T. Sindall, Hon. Secretary of the Lincoln S.M.E., who told me about it in a letter which I received soon after his visit. The little "Dyak" certainly "astonished the natives" with her performance; and the success he made of the building, has stimulated our worthy friend to further efforts. He is now building "Fayette," the 4-6-2 which I described in these notes many years ago, and has just acquired the castings and material for "Doris," so he says his workshop should be busy for the next two years or so. The workshop contains a lathe, milling and drilling machines, and the usual assortment of tools; the machines are electrically driven.

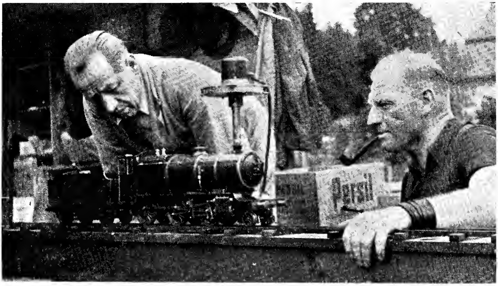
Our friend says he considers that I "take part in the success of his engine," because of the instructions given in my notes; but I consider the credit goes to him for the way in which he carried out the instructions. It is easy enough to, say, get some paint and brushes, and apply the paint to a piece of canvas by means of the brushes; but without the necessary degree of workmanship on the part of the operator, the resulting picture might not qualify for a prize in the Royal Academy show! Anyway, hearty congratulations to Mr. Schweizer on his efforts at locomotive-building, and good luck to "Fayette" and "Doris" two coming "maids of Switzerland."

A South African "Fayette"

The Alps are rather chilly, so let's head south to a warmer climate, and make Johannesburg our next port of call. Friend George Perrem lives here, and he has been mighty busy lately, finishing off a "Fayette" type engine in $2\frac{1}{2}$-in. gauge for a friend. Thereby hangs another tale. Soon after I started writing my locomotive notes

in this journal, I made the acquaintance, by correspondence, of a citizen of the Celestial Empire, to wit Jim Tuling. As he signed his surname as one word, and writes perfect English in a very legible hand, I would never have guessed he was Chinese if he hadn't told me right away. However, he was very keen on locomotives, and as he had not anything of his own in that line, he started in with the good-natured persistence of his race, to worry for something out of my workshop. At that time, well over 20 years ago, I had only the little " first-floor back " at Norbury with a pedal-driven lathe, a hand-operated bench drilling-machine, and not a wonderful lot in the way of tools and equipment; but being that much younger, and only writing one weekly article, I had a bit of time available to do locomotive building and repairing, both for personal friends, and a few selected readers of this journal. I might add, that after the success of old " Ayesha " at the Caxton Hall, and the appearance of the " Live Steam " columns, I was absolutely snowed under with requests to build and repair little locomotives; and if I had possessed the resources, could have started a small works easily.

At first I told friend Tuling that I couldn't do anything for him, and he wrote that he was terribly disappointed. If I could only let him have the start of an engine, say the frames, with the horns and axleboxes on, he could carry on himself; he suggested " Fayette." After several letters had passed, I said I'd try to fix him up; and in between writing and other jobs, I managed to make the frames and put the bits on. When I told our friend it was ready, he said, couldn't I manage to put the wheels and axles on it whilst on the job? I had a quiet grin—I'd read about a certain characteristic of the Chinese! —and said O.K., and after more scheming for time, on went the wheels and axles. I also made the coupling-rods and fitted them. Then along came another letter. Our friend said he didn't think he could make a pair of cylinders, so would I fit those also? By way of " bait " he sent a draft order on a London bank, for the cost of the job, so there was no question about his sincerity, and his eagerness to get an engine. Well, to cut a long story short, as Nat Gubbins would say, I made and fitted the cylinders, working half through the night on several occasions when I could do a job which wouldn't disturb the next-door neighbours, such as tapping and screwing. I also fitted a pair of Baker-gear frames on each side. I didn't tell friend Tuling this time, when I had done the needful for his latest request, but packed up the whole doings in a box, and delivered it to Cook's, for transport to South Africa. I was all behind in commitments for friends at home, and just couldn't do any more.



Getting up steam on the Swiss " Dyak "

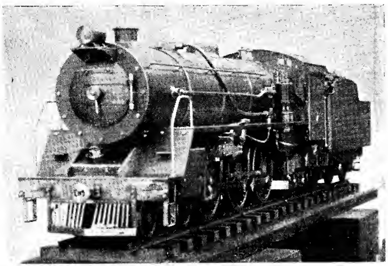
I knew our friend would be disappointed, because I could see that his intention was for me to keep adding bits to the chassis until it became a finished locomotive. Although he got the box all right, with the contents undamaged, and was satisfied with what I had done, he was rather disconsolate, saying he didn't know now whether the engine would ever be finished. Incidentally, this was the part-finished chassis that two visitors from England found fault with, because it wasn't finished off in Science Museum style. If they had seen the conditions under which it was made, they might not have been so critical; I did my best under the circumstances, trying to oblige a friend. One doesn't feel like polishing out tool-marks, for instance, at three o'clock in the morning, when it is a job to keep one's eyes open! I therefore concentrated on the parts that mattered.

At long last!

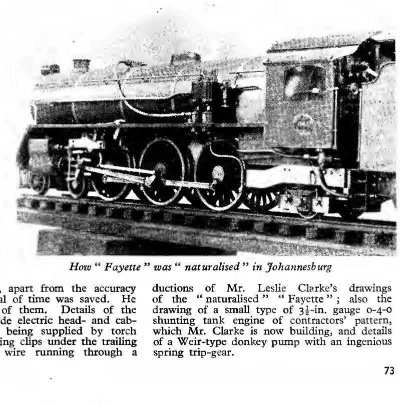
Nearly 20 years rolled by, and the chassis remained in the *status quo*. Meantime Mr. Tuling had become friendly with, among others, Mr. George Perrem; had seen the latter's workshop, and the locomotives he had built, and finally persuaded Mr. Perrem to undertake the job of finishing the engine. Meanwhile, Mr. Leslie Clarke had arrived in South Africa, and had joined the merry band of locomotive builders; he had been trained in the G.W.R. works at Swindon. He undertook to prepare drawings "naturalising" (I nearly put "nationalising!") old "Fayette" to South African outline; Mr. Perrem got busy, and the result you see in the pictures.

The Baker valve-gear was finished off with a set of jigged levers supplied by Mr. Summerscales, of Cosham, Hants, and Mr. Perrem says that by using these, apart from the accuracy obtained, a great deal of time was saved. He speaks very highly of them. Details of the finished engine include electric head- and cab-lights, the "juice" being supplied by torch batteries held by spring clips under the trailing end, the headlight wire running through a handrail made from rustless steel tube. The superstructure is made from 20-gauge steel plate, and is at present unpainted. In place of the original tender specified, a six-wheeler of conventional pattern is fitted, which makes it easier to get at the inside of the cab, for driving and firing. Mr. Perrem says the steam trials were very successful, and he was very pleased with the way the locomotive performed. I guess our Celestial friend was, too, after the length of time he had waited to own a good working locomotive; I understand that he now has a "Juliet" under way, and don't imagine this one will be quite as long as the South African "Fayette" before she takes the road.

If all goes well, and our good friend who wields the blue pencil doesn't raise any objections, I hope to include, in the very near future, reproductions of Mr. Leslie Clarke's drawings of the "naturalised" "Fayette"; also the drawing of a small type of $3\frac{1}{2}$-in. gauge 0-4-0 shunting tank engine of contractors' pattern, which Mr. Clarke is now building, and details of a Weir-type donkey pump with an ingenious spring trip-gear.



Started in England, finished in South Africa



How "Fayette" was "naturalised" in Johannesburg

Over to the U.S.A.

One fine day in May, 1893, the Empire State Express, forerunner of the Twentieth Century Limited on the New York Central R.R. pulled into a division point on that line considerably behind time. Charlie Hogan, with a big-wheeled 4-4-0, backed on to the train, which consisted of four cars only, and received instructions from the conductor (guard, in this country) (Toad, Swamp and Punk Hollow R.R.) about two years ago.

In passing, I have heard from several correspondents in U.S.A. and Canada, that the last meet of the Brotherhood of "Live Steamers" at Danvers, Mass. went off as well as ever, most of the old-timers being present, with a few new members as well. There was a goodly array of engines. I often wonder why something of the

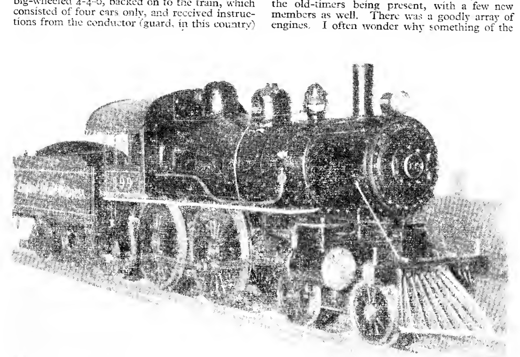


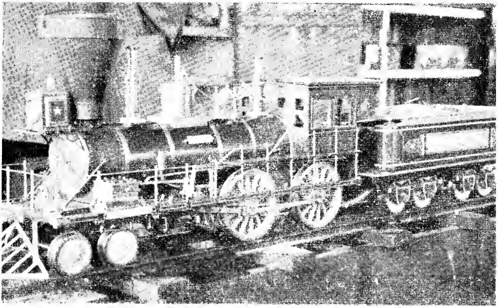
Photo by *A. W. Leggett*

Ed. Bergh's $3\frac{1}{2}$-in. gauge edition of Charlie Hogan's "ground flying machine"

to make up as much lost time as possible. Nothing loth, Charlie let old "999" go for all she was worth; and passengers in the train who checked the speed, reckoned that the maximum rate attained, was $112\frac{1}{2}$ miles per hour. Such a speed was ridiculed in this country, and the calculation fraternity proved by figures, as usual, that it was "impossible." Personally I don't doubt it at all. With only four cars, a big-wheeled engine that was the star performer of a class second to none for free running, an engine crew who knew the job, and a favourable gradient, there is no earthly reason why "999" shouldn't have attained nearly two miles per minute, as easily as our own "Mallard" of the L.N.E.R. just exceeded it. I happen to know, from personal experience, what old "Fairlight," "Lullington," and a few other Brighton "high-flyers" could do if you let them out when going down through Haywards Heath. Anyway, the engine gained notoriety, and some of our fraternity in U.S.A. have paid their respects to her memory by building small editions. Here is a picture of one in $3\frac{1}{2}$-in. gauge size, built by Ed Bergh, of Diamond Point, N.Y. The photograph was taken by Bill Leggett, of Montreal, when Ed brought the engine along for a run over Bill's line sort isn't arranged in this country. Our cousins don't think so much in terms of distance, as we do. However, there certainly was a sort of "distant signal" to such an event, when visitors came "from far and wide" to the opening of the Birmingham S.M.E track. By the same token, as Pat would say. Birmingham would make an excellent venue for an annual meet of British "Live Steamers"—a nod is as good as a wink to a blind horse—what about it? You couldn't have a better geographical location, and I'm jolly certain you couldn't have a better road!

An Old-timer

One of the most interesting jobs seen at the Danvers meet was the $3\frac{1}{2}$-in. gauge Hinkley old-timer 4-4-0, built by Mr. F. S. Wyman, and shown in the reproduced photograph. I haven't any details of her, except that she has everything her big sister carried, including a crosshead pump, and a cab made of mahogany. Some of our cousins certainly go the whole hog when they set out to build a reproduction of any particular full-sized locomotive. Note the decorative boiler mountings, spark-arresting balloon stack, and railings all around. It is hardly necessary to add that she works all right!



Locomotive artistry by Mr. F. S. Wyman

Another kind of " live steamer "

A few weeks ago I drew attention to the fact that because a small locomotive was described as a " live steamer," it didn't necessarily follow that the engine was built according to the specifications set out in these notes. In confirmation of this, I have just received from a friend in U.S.A. a leaflet describing commercial locomotives and rolling-stock for $7\frac{1}{2}$-in. gauge lines. The rolling-stock is built from plywood, and both diesel and steam locomotives are listed. The " diesel " consists of a small petrol engine mounted on a board carrying the bogies or trucks, the drive being by a roller chain ; but the steam locomotive —well, they call it a " live steamer." Listen to the specification ; I quote from the leaflet. " This American type 4-4-0 locomotive . . . has $2\frac{1}{2}$-in. by 3-in. cylinders with piston-type valves. It has a reversing throttle, so that only one lever is used for control and braking ; this eliminates the complicated linkage and the second set of eccentrics. This engine is so designed that all work can be done on a lathe or drill-press ; there is no planing, shaping, or keyways . . .

I Don't Wonder !

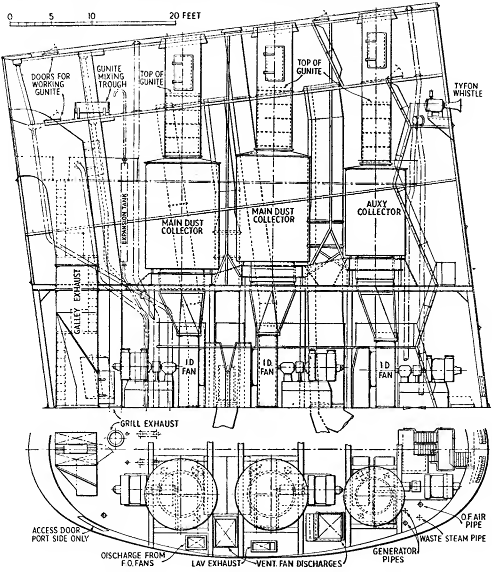
" The boiler is of welded construction and is designed to A.S.M.E. code. The shell is of standard 10-in. pipe, the smokebox of 8-in. pipe, with a 10-8 welding reducer between them. The firebox is of 6-in. pipe with twelve 1-in. fire tubes. The injector, pop-off, gauge and other parts are standard fittings available at your local plumbing supply. Fired by coal or a kerosene weed burner." Alongside the last paragraph is a photo reproduction showing the boiler. The 6-in. pipe firebox projects slightly from the circular backhead, is open at the end, and a big blowlamp burner is directing a flame into it. The burner is connected by a flexible tube to the oil container. The following paragraph naively states that " because of conflicting boiler codes in various states, we are not offering the complete boiler." I don't wonder ! !

Comparisons

Well, for curiosity's sake, compare that specification with the " Maid of Kent," especially the valve-gear, which is the same as on the Jerry toy locomotives of gauges " O " and " 1," and used to be sold in this country in the days gone by, at very cheap prices. Early cut-off is not possible when using a valve for reversing, which simply changes over the steam and exhaust ports ; and with 100 per cent. cut-off, the amount of steam wasted by the cylinders, even with the best of workmanship, is absolutely appalling. No provision is made for superheating ; and how on earth a coal fire in a 6-in. pipe is going to provide enough " therms " for a pair of cylinders of the given dimensions, taking steam for full stroke, is something that leaves your humble servant guessing. It says that all work can be done on a lathe or drill-press ; the set of castings are supplied unfinished, except that the cylinder-block is bored and faced, and I'd dearly love to know how the coupled wheels are turned on a drill-press ! The outline drawing of the engine shows a quite respectable example of an American 4-4-0 ; and to my way of thinking, it is quite a pity to spoil it by specifying such inefficient and clumsy details. A proper valve-gear, and correct type of boiler, would make all the difference in the world ; and the little extra work involved, would well repay anyone building the engine.

FASHIONS in FUNNELS

IN the early years of this century, when the size of the steamship and, consequently, the size of its power unit, was increasing at an enormous rate, the fashion was to increase the size and number of funnels to correspond. The famous sisters, *Mauretania* and *Lusitania*, each had four enormous funnels. Several of the Castle liners were fitted with four funnels, although later some of them were rebuilt with only one or two. The craze for large and numerous funnels reached its height in the case of the *Empress of Britain* where the funnels seemed out of all proportion to the size of the ship. The French liner *Normandie* had three tremendous funnels, and this was also the case with the *Queen Mary*, although here they were somewhat smaller and made more in keeping with the size of the ship. That three were unnecessary was shown by the fact that one was a dummy and was used for various purposes other than the normal one. In the



Interior details of " Caronia's " funnel
Reproduced by kind permission of [" *Shipbuilding and Shipping Record* "

Queen Elizabeth, the dummy funnel was dispensed with. In a number of recent liners, a large single funnel is used, and this now seems to be the fashion for all large modern ships. The new Cunarder *Caronia* has one enormous funnel, probably the largest one fitted so far on any a-block with various fittings, as will be seen from the drawing here reproduced. These are four uptakes from the main boiler and two smaller ones from the auxiliaries, all of which are fitted with elaborate dust collectors, not to mention the numerous ventilating fan discharge pipes

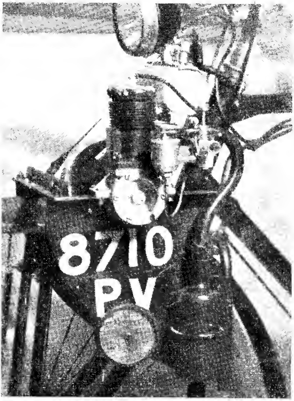
steamer. It is oval in section, and measures approximately 52 ft. by 26 ft. and is about 50 ft. high above its casing. In contrast with the funnel of H.M.S. *Repulse*, shown on our cover for June 17th of last year, and which was comparatively empty, the *Caronia's* funnel is chock- and the exhaust from the galley. The interior of the funnel is provided with platforms and ladders giving access to the various fittings. The Tyfon whistles are located inside the funnel, with only the trumpet projecting. Does this represent the limit in this fashion?

The "Miniauto" Motor Bicycle

Winner of the Challenge Cup at the Exhibition of the Ipswich Society of Model and Experimental Engineers

by R. N. Ostler

HAVING dabbled in small internal combustion engines for some considerable time, it occurred to me that instead of watching the wheels go round and generally making myself a nuisance creating noises akin to V1's etc., why not make one to work for me, if only to help conserve the energy required by us poor cyclists.



The power/weight ratio of small internal combustion engines is generally reckoned to be very good, so I designed a simple two-stroke engine which I considered would be the smallest practical engine to propel the average person on a cycle on reasonably level roads at a speed above the average of its pedal-operated counterpart. The engine is a simple two-stroke about 25 c.c. with the conventional transfer ports, etc. The crankcase is cast aluminium and the cylinder, good grade cast-iron. No cores were used in the patterns, and castings were machined from solid. The crankshaft is built up, crank disc and crank-pin turned from solid and the centre bored a force fit for $\frac{1}{2}$-in. diameter silver-steel shaft, which was pressed in and pegged.

Crankcase cover, connecting-rod and piston are of dural, the latter having three cast-iron rings fitted of the stepped pattern.

The connecting-rod has a phosphor bronze bush at crank-pin end, and the gudgeon-pin is $\frac{5}{16}$-in. diameter silver-steel, bored through $\frac{3}{16}$ in. diameter for lightness.

The cylinder was bored and fins turned from the solid, ample size bosses being cast on to accommodate exhaust and inlet manifold and transfer port. The latter was drilled up the boss from the base, then across into the cylinder, the outside holes afterwards being plugged up.

Cylinder cover was turned from dural and fins cut by hand, using two blades together in hacksaw frame to get the width of slot.

Engine crankshaft runs on three light type ball-races two in crankcase (with sealing bush between) and one in aluminium housing at end of crankshaft.

The drive to the tyre is by aluminium roller, turned slightly concave with diagonal saw-cuts round its periphery, and the ratio to a 26-in. cycle wheel is 10 to 1.

The whole engine unit is mounted across two soleplates of 14-gauge steel, which in turn are arranged to swivel on its anchorage at the back of cycle fork. The front fixing is by two telescopic spring forks attached to front wheel spindle.

Free engine device is by Bowden cable anchored at handlebar adjusting bolt and attached to soleplate spacing angle.

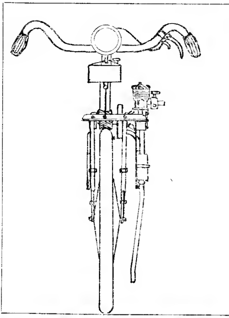
The Bowden cable hand-lever on handlebar has a spring-catch to hold engine in free position if the rider wishes to cycle for a change.

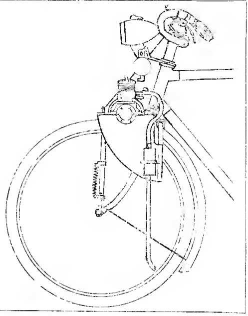
Ignition is by coil and dry battery, both of which are carried in rear cycle bag. The original battery (6-volt Lanternlite) is still in use after $4\frac{1}{2}$ months, which is due to shape of contact-breaker cam.

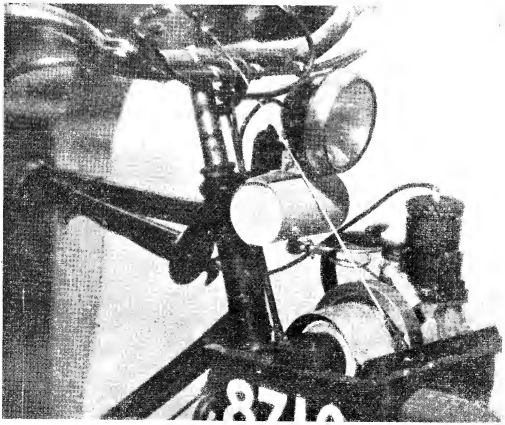
Sparking-plug is $\frac{3}{8}$ in. $\times$ 24 t.p.i. of the Champion model aircraft engine type.

The performance of this little unit far exceeded

(*Continued on page 81*)



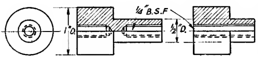




Power Tools from ex-R.A.F. Motors

by C. Law

HAVING acquired two *ex*-A.M. electric motors, I set about devising ways and means of using them to the best advantage. I was fortunate in having a 230 v. input, 25 v. output transformer rated at 100 v.a. and as these motors are for 24 v. and take about 4 amps. this solved problem No. 1. Incidentally these motors are of the type advertised in THE MODEL ENGINEER at various times, and were used in aircraft for operating the cooling gills on radial aero engines. The complete unit consists of a series-wound split field-motor with one-piece laminated yoke and pole shoes, one or other of the fields being used for opposite rotation. The armature shaft is hollow and carries a spindle with single plate clutch between the motor and the gearbox. The gearbox is a lovely piece of engineering and consists of a four-stage epicyclic reduction gear giving a reduction from motor to final drive of 625-1. As my most urgent need was for a small bench grinder I commenced by removing all covers and the gearbox together with electrical contacts, electro-magnetic clutch (used for automatic motor reversing) leaving the base motor.



Adaptors for spindle ends

The hollow armature shaft was opened up to ¼ in. and a piece of ¼-in. diameter silver-steel screwed 26 t.p.i. each end and cut to protrude 1 in. either end (the original spindle being dispensed with). Two adaptors were made (as sketch) to take 3-in. × ½-in. × ½-in. carborundum wheels, from ¾-in. mild-steel bar and screwed on to the spindle ends. I was lucky in borrowing a wood pattern which required little alteration for the stand, and I had this cast in C.I. locally. Holes were drilled for two ¼-in. B.S.F. Allen screws in the motor body and the stand. A layer of cork gasket packing about ⅛ in. thick was fitted between the motor and stand to absorb vibration. A small toggle switch was fitted to the base and the motor wired up. I dispensed with one field lead using the field required for correct rotation. I experimented with a spare stator core by rewinding half the number of turns of one existing field coil on to each of the two fields, but found no gain in power, so reverted to using one of the original. If this ever burns out I can always re-connect and use the other field. I estimate the approximate r.p.m. at 5,000, and find the power is ample for grinding turning tools, etc. I have since made extra spindle adaptors to take wire brushes and polishing mops.

A start was now made on the second motor. I had wanted a portable electric hand drill for a long time and I saw the possibilities if I could use some of the gearing on the unit. As each train is a multiple of five, by using one only would give a 5 to 1 reduction, i.e. approx. 1,000 r.p.m. This was decided upon and with a

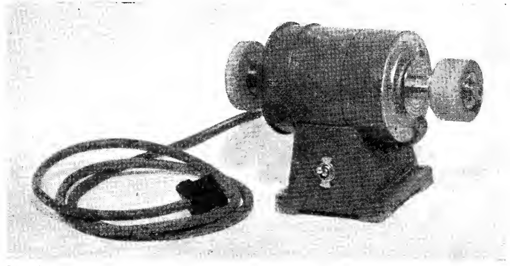


Photo by] [*J. H. Oliver*

The complete bench grinder, with two grinding wheels

$\frac{1}{4}$-in. capacity Jacobs type chuck, I have found in practice to be entirely satisfactory. The unit was stripped and a start was made by reducing the long steel sleeve, which is splined internally to the required length for the single gear train. The splines were then turned off for a suitable depth and screw-cut to receive the existing end-cap. The splines on the live spindle end were turned off and threaded to receive the $\frac{1}{4}$-in. chuck. As the cap is already bushed for the spindle for about $\frac{3}{8}$ in., the only requirement was a means of taking care of end-thrust. A brass collar was turned to receive a race capable of taking radial and end thrust, and the collar was then fitted to the cap by three 4-B.A. set-screws. Reverting to the spindle again, the shank was marked off for position of the thrust-race and screwed 26 t.p.i. for $\frac{1}{4}$ in. at the chuck end. The end of the thread finishing just inside the bore of the race. Two ring-nuts were made, one to bear against the inner race and the second to act as a lock-nut after adjustment for end-float of shaft. A dust cover for the bearing was made from the sheet brass with a felt ring held in place with "Bostic" to act as a grease seal. The next item was the handle. After unsuccessful attempts with wood, I finally used two pieces of $\frac{1}{2}$-in. sheet bakelized fabric. These were held together with 4-B.A. screws and the handle shaped by sawing and filing. A groove was milled up the centre, also a recess to carry the supply wire and a toggle switch. Two 2-B.A. studs were fitted to each end of the handle and suitably positioned clearance holes drilled in the motor end frame. The existing alloy cover off the electrical change-over gear was fitted to the motor end after cutting and filing to clear the handle ends. The motor was wired up in the same way as the bench grinder, using the one field to give correct rotation. The gear chamber was charged with light grease, also the thrust-race. The drill has ample power for all drills up to its maximum capacity of $\frac{1}{4}$ in., and I consider that I have two very serviceable tools made for less than the cost would be for any one of them through normal channels. I have fitted the transformer I use for supply into a wooden carrying case with leather strap handle for use when the drill is required away from my workshop, such as the garage, etc.

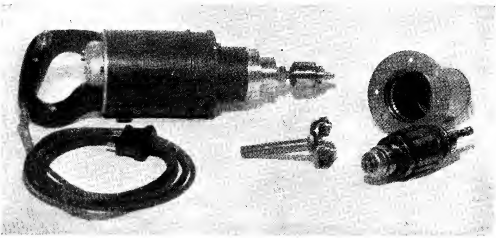


Photo by] [*J. H. Oliver*

Photo showing the complete drill; the internally splined sleeve (before machining); armature shaft with spindle and clutch in position; and a live spindle (before machining), with three planet gears in position

I shall be only too pleased to supply any further details to any readers interested.

The "Miniauto" Motor Bicycle

(*Continued from page* 78)

my expectations, and although it has been in regular use for the past 7 months, it shows no visible signs of wear or distress in any part.

The carburettor is of float pattern with bottom feed and cork float with revolving throttle and adjustable jet needle. No adjustment is needed when set, and the engine will purr along at 20 m.p.h. and also at a walking pace, two-stroking all the time. Four-stroking can only be achieved by over-running the engine down a hill. Wear on the tyre is negligible, and petrol consumption somewhere around 350 m.p.g.

The taxation class is the same as for auto-cycles or under 250 c.c., and what a nice little book of coupons you get!

I might mention that all machining was carried out on a home-made plain lathe, no screw-cutting, no back gear, and only a bell chuck, but with heaps of enthusiasm and remarkable Heath Robinson rig-ups.

TWIN SISTERS

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

by J. I. Austen-Walton

THE enormous increase in the building of small locomotives in recent years has established, not only a fascinating hobby, but almost a small industry. One wonders where such a movement might end—if ever—and conjecture on the probable future of this work in connection with some of the most recent advances in design, the diesel-electrics and so forth.

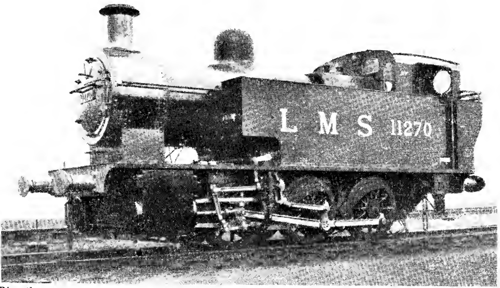


Photo by courtesy, *British Railways*

The L.M.S. 2F dock shunter

Personally, I would hate to see the end of the beloved steam locomotives, especially with the now-improved facilities more generally found in the possession of the keen amateur builder. The recent war has brought many new men into the model-building world—men who have learned to do accurate work on good machines, and often, on indifferent machines.

By and large, the average home worker has a far better list of tools than he had say, ten years ago, and generally, I would say he is more proficient in every way.

It is possible to get some kind of confirmation of this point with the now general trend towards the building of bigger and better models, and here I am almost tempted to say "only bigger, and not so much better in proportion."

As a large-scale model builder myself, I have very definite views on this matter and, although generally I am quite in sympathy with the man who still wants a simple locomotive, but larger in order to carry more passengers, or more fully to capture realism in doing it, I feel that actual realism should grow with the size of the job and that things like working scale details and correct finish do still appeal to those builders who are both realists and artists at heart.

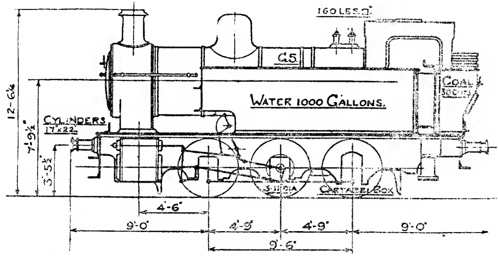
At the moment I am in the world of 1-in. or $1\frac{1}{16}$-in. scale, or 5-in. gauge. I feel that this size does give one a chance really to get down to scale without loss of appearance or performance. The large scales of $1\frac{1}{2}$ in. and over are still better in that respect, but the problem of transport then becomes the vexed question.

Most 5-in. jobs are heavy—calling for a two- or three-man lift for loading or unloading, and that fact alone deters many who would otherwise go all out for the bigger gauge. For the lucky ones who have big cars and often large gardens with reasonably-sized layouts—projected or in existence—the use of a locomotive capable of getting round sharp curves without fears of binding or derailment is essential. I have seen many characterless garden schemes put down just because the minimum radius case has prevented the use of anything other than the monotonous oval, or even circular, track, where one or two deflections past trees or round the back of the

greenhouse would have made all the difference.

For passenger-hauling, a small 5-in. gauge locomotive should pull to the limit of its adhesive weight—the maximum possible in any case, and you are going to be contented with twenty-odd adults per load, all very well.

Through the many requests I have received, and without the fear of treading on anyone's toes I have prepared the specification for a specially-detailed locomotive in which I have particular confidence, but to present the work in acceptable terms to those who have become accustomed to water pump of a new design. This particular pump has been made and tested, and after some hundreds of hours of continuous working, has emerged with flying colours. Its main characteristics might be described as follows: a very wide range of working speeds from one stroke every two seconds (that's pretty slow when you see it!) up to two hundred strokes per minute, which is seldom necessary. Fitted with slide-valves, it is self-condensate—clearing, self-starting and requires no lubrication at all when working on wet steam. I would say that it is



making the simpler types would precipitate them into certain complications that might be embarrassing to themselves and to myself as well. After the most careful consideration I believe the solution has been found.

The specification I am about to give is broadly divided into two classes. That is to say, the locomotive is being made into "Twin Sisters," one being the fully-detailed form and the other the simplified version. Both will be described concurrently. Of the fully-detailed version, there is little to say at the moment, but the simplified version means a finished job without too much lost in appearances, and a locomotive having just a little more than the average detail and finish. Most of the details to be put on the full version could be added to the simple form without structural alterations. Alternatively, many details could be omitted from the full version without serious results. I would, of course, prefer to stick to the two distinct classes, calling them, for future reference, "Major" and "Minor."

The basic design is the L.M.S. dock-shunting locomotive, 0-6-0 wheel arrangement and outside cylinders with Walschaerts valve-gear. The following details should give some idea of the specification of the job.

The particular emphasis on detailed accessories includes some quite interesting gear. For example, steam brakes, working sanding gear, working drain cocks (from cab) and, in the case of "Major" a twin-cylinder, double-acting feed-

easy to make, but tricky to assemble and can be constructed without the use of castings if desired.

It is intended to fit "Major" with this pump and no track-driven pump at all, but the simple water-pump designed for "Minor" could be added. The eccentric that will be fitted to both engines for working the lubricators will enable the water-pump to be fitted, if necessary later, to either or both jobs.

"Major" will have driving wheels with steel tyres and roller-bearings to all axles of a type that can be made at home. Working "leaf" springs, valve-gear in stainless-steel (optional), slide-valves as per prototype and a wealth of working details that are only too seldom described.

The plate-work has been tied up very well in both jobs and I don't think anything could go seriously wrong, even when they get to the job of lagging the boiler and firebox, while the dome and chimney have been prepared in casting form, and present no snags at all.

The cylinders are to be offered in two forms, one in cast-iron with cast-iron pistons and piston rings, and the other in gunmetal with either a bronze or stainless-steel piston and having the well-tried and quite satisfactory graphited cord ring. I can't help favouring the cast-iron story for "Major" and, in spite of stories of corrosion setting in, I have never yet seen a cylinder that has taken the count because of rust—at least, not in any job that has had *reasonable* care and with cylinder bores that were properly finished inside and given normal lubrication with the correct oil.

With the corrosion bogy laid, there is no other material that will give such wonderful service and resist wear so well as cast-iron and, as a final word of recommendation, I am using it myself—if that means anything.

I am not going to insist on steel for the tyres, as the cost of doing this is greater, although it provides, at the same time enough metal cut from the centres of the blanks to make crossheads and a few other bits ; but I will recommend ordinary mild-steel tyres that can be gas-profiled out of steel plate and machined to size. The cost should not be too great for a quality engine.

I fully believe that our trade friends will be able to cope with this situation without much difficulty. There is quite a good reason for calling for steel tyres, as the extra grip they afford is quite appreciable, and it brings the job well in line with full-size practice. However, for those who cannot, or will not, comply with this part of the specification, the all-cast wheels arranged for "Minor" will be on sale.

Sooner or later, I am bound to be asked quite a number of questions relating to stainless material and, as these notes proceed, I shall continue to recommend its use in a wide variety of parts. There will always be the alternative material cited, but in cases where I feel that stainless simply must be used, there will also be notes on the machining methods to be employed and suggestions and sketches relating to tool forms and angles—I can't do much more than that at present, and we won't shy at fences that we haven't yet reached. In this connection I have arranged to make a number of parts at the time of the description appearing, and, by so doing, I shall be in touch quite intimately with the problems immediately at hand.

The question of service brings up another point. If you want to build and run a small locomotive, the cleaning and servicing becomes a front line problem and, in 5-in. gauge, it deserves to be dealt with in a far-seeing and practical manner.

The design of both "Major" and "Minor" permits of the removal of the boiler *en bloc* without excessive bolt trouble—let's say ten minutes from start to finish. That isn't too bad. Having got the boiler away, the removal of one screw cap under the dome reveals the regulator. A further three nuts to undo, and the entire superheater system draws out. So much for the boiler.

The bare chassis, with the exception of the side tanks, is left, and these two are removable quite easily. Cleaning is now a straightforward job. Two large caps, normally hidden under the running board, are removed and both slide-valves can be fully seen and, if required, checked for timing and position. A "putting away" dose of oil can now be squirted in, and the caps replaced.

You can see now why the liberal use of stainless-steel is so helpful, for the job of finally protecting by a film of oil the parts subject to rust, is quite superfluous, and the cleaning operation takes minutes instead of hours. That, to my mind, is alone worth the extra trouble and expense.

By way of rounding off final and general descriptions, details—external and internal—come into focus again. Because both "Major" and "Minor" have been fashioned on lines closely resembling the prototype, you will find that certain parts are quite intricately made and quite a number of these are well out of sight when the job is completed. You may not, of course, see any good reason for this, but personally I derive great satisfaction from the knowledge that the details are correct even when unseen by the casual observer, and I at least hope that most of you, in tackling this particular job, will be ready to share in this view.

There are other considerations worth looking into, and the problem of equipment is certainly one of them. The first essential is, of course, a lathe. I built my first 3½-in. gauge Pacific on a "Wade" lathe, only to find that the driving-wheels wouldn't go in (very bad planning, was that !) and this part of the job had to be done on the end shaft of an ordinary domestic mangle ! I think most people I have told believed that I was pulling their legs, but it's perfectly true, and I break out into a cold sweat at the thought of the agonies I went through to achieve this object.

Nowadays, it is usual to find the much-favoured Myfords, 3½-in. or 3⅜-in., in a number of home workshops ; but, in my travels about the country I have been pleasantly surprised to see quite a few of the heavy-duty Myford M.L.7's performing quite evidently to the satisfaction of their proud owners, whilst the "Halifax" (late "Sphere"), "Atlas" and "South Bends" were not to be counted singly.

Fortunately, both "Major" and "Minor" have few large turned parts — nothing exceeding five inches in diameter, so that the 3½-in. lathes come into the picture quite well for normal turning, but some milling jobs may cause anxiety and are worth examination now.

Of these, the milling of the flutes down the connecting-rods and coupling-rods is probably the worst case, and the use of some kind of milling slide, vertical or horizontal, would be a useful, if not essential, investment. I know it is possible to do such work by the supposedly simple expedient of shifting the work along in stages, but to do so calls for some little skill and lots of patience. In this connection, it is up to you to decide whether or not these last-named virtues will see you through, or whether the purchase or loan of a suitable slide would not be the wisest course to adopt.

The boiler is an entirely different job, and in its early stages calls for little more than brute strength and blocks of wood. It is when the brazing or silver-soldering begins that the question of blowlamp or torch arises. To make the job as easy as possible I shall describe an all-silver-soldered boiler, in that it calls for the lowest working temperatures, quite within the range of a 5-pint blowlamp and a little coke.

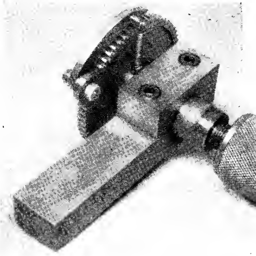
I prefer a fair-sized gas-air blowlamp where possible. I like the ease of operation, the absence of preliminaries, and the freedom from fear of a prematurely empty petrol or paraffin tank, always at the critical moment !

For absolute luxury (in which, I admit, I, myself, indulge) the oxy-acetylene torch is definitely the last word. I happen to know of

(*Continued on page* 88)

A Tool-post Indexing Device

by "Ned"



The indexing device with clamp holder arranged for tool-post mounting

THIS modest but extremely useful item of lathe equipment was evolved from very simple beginnings, arising out of the practical need for some means of holding small round stock at centre height for light slotting or milling operations. The most common application for such operations is in slotting small screw-heads, and while it is quite easy to carry this out without machine-tool aid, by the use of a hand saw, it is not so easy to do this really neatly, and most screws which have been slotted by hand tend to look somewhat untidy on close inspection. Very often the slots are out of centre, ragged in finish, and not uncommonly a false start or slipping of the saw results in marring the face of the head.

In cases where screws have to be made in quantity, specialised appliances or machine fixtures, more or less elaborate in design, are generally used; but for slotting an occasional screw, it is essential that the fixture should be simple and capable of being fitted up and dismounted very rapidly, otherwise the time absorbed is not justified. The method first used by the writer for this purpose was to hold the screw in a cheap drill-chuck with a parallel shank which could be held in a split tool-holder, or on a vee packing-block, in the lathe tool-post. This fulfilled the main requirements fairly well, and as the slotting operation did not entail any severe cutting stress, it was found that the screw could be held sufficiently firmly by this simple chuck, without marring the threads perceptibly. In this respect, it may be noted that a more expensive form of chuck, though capable of holding the work more firmly, would tend to bruise the threads unless they were protected by screwed bushings or soft linings ; all of which would tend to make the fixture more complicated in use.

This very primitive holding fixture—if indeed it could claim to be called a fixture—was not, however, without its practical disadvantages. In the first place, the height of the centre-line of the chuck had to be adjusted by packing, as it is clearly desirable that this should coincide with that of the lathe centres, so that the concave slot formed in the screw-head should be of equal depth at the edges ; and this adjustment wasted valuable time when a rush job was in hand. The overhang of the chuck from the front of the tool-post, when held in this way, was rather excessive, and if the screw being dealt with was fairly long, it was not supported as rigidly as might be desired.

It was in some cases found desirable to have some means of rotating the work after fixing it in the chuck, but this entailed loosening the holder, and probably disturbing the location of the chuck. The obvious possibility of being able to carry out simple indexing of work held in this way made it desirable to improve the method of mounting so that the chuck spindle could be rotated without disturbing the holder.

In the final form of the fixture, shown in the illustrations, the chuck spindle is held in a bush or " quill " which in turn is clamped in a split " plummer block " type of holder, the lower component of which is extended to form a square shank for convenient mounting in the tool-post. At the tail end of the spindle, an indexing plate of some kind is attached ; in the particular case illustrated, this consists of a spur gear-wheel having an appropriate number of teeth for the range of divisions required. This serves its practical purpose quite well and is usually the easiest thing to obtain, but a specially-made drilled and notched division plate with an appropriate form of detent or index pin may be fitted if preferred. A 60-toothed wheel gives a convenient range of divisions.

The shank of the holder is made of rectangular mild-steel bar of suitable section to mount in the tool-post, and in some cases it may be found necessary to reduce either the height or the width at the shank end, though the parallel section shown fits either the Myford M.L.4 or M.L.7 lathes, and enables the division line to be made exactly on the level of the lathe centres without the need for packing or other adjustment. A short piece cut off the same bar is used to form the top half of the clamp, and is secured in place by two sunk-head ¼-in. Allen screws, after which the seating is bored from the lathe chuck, with

the assembled holder mounted in the tool-post. In this way, the correct height of the chuck spindle is positively assured.

The object of fitting the spindle in a quill bearing is to enhance the versatility of the fixture, as it enables the complete spindle and indexing gear to be slipped out of its holder and used in some other form of mounting—on the vertical slide, for instance—while the split clamp may be used to carry other fittings, such as a collar is pressed on and firmly pinned, then finally machined in position with the spindle running between centres. By coning the back face of the collar, endwise adjustment of the spindle also takes up any side play which may exist in the quill bearing. A thin nut is used at the back of the spindle to take up end play, and this is locked by the division plate when the latter is keyed on, and further secured by the nut at the outer end.

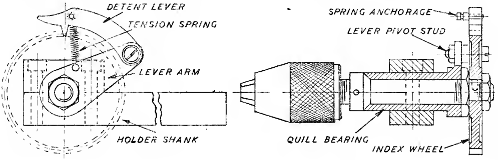


Fig. 1. *End and side elevations of indexing fixture*

a round-shank boring-bar or a light drilling or grinding spindle. In the method of indexing employed, it is convenient to attach the arm which carries the detent lever to the rear end of the quill; any method of attachment is suitable so long as it provides the requisite rigidity.

The detent lever is made from mild steel, with the indexing tooth either cut from the solid or brazed on; it should be shaped to fit neatly into the teeth of the index wheel without bottoming, and the eye end of the lever should be wide enough to provide a substantial bearing on its pivot stud, the fit of which should be good. In the event of a drilled division plate being used,

In addition to the original purpose of the fixture for screw slotting, it can now be just as simply applied to forming the heads of small hexagon bolts, or squaring the ends of taps or reamers with the aid of an end-mill or facing cutter. Time may be saved in milling hexagons or squares by using two cutters—thick slotting saws will do—spaced out by a collar on the arbor, the same thickness as the required size across flats, so as to work simultaneously on both sides of the head, and finish the job in three indexing operations for hexagons, or two for squares. This method, incidentally, relieves the chuck spindle of all torque strains.

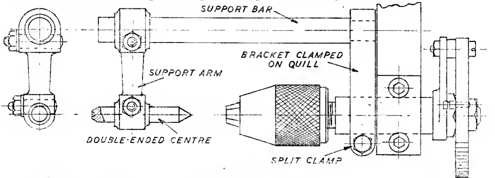


Fig. 2. *Plan view of fixture, with suggested attachment for supporting long pieces of work*

this pivot may be substituted by a shouldered stud carrying a fairly heavy spring blade with the index-pin attached to the end. With the pivoted lever, either a torsion spring on the pivot stud, or a tension spring between the lever and the arm, may be used to keep the detent in engagement; in either case it should be fairly strong to prevent the risk of inadvertent movement.

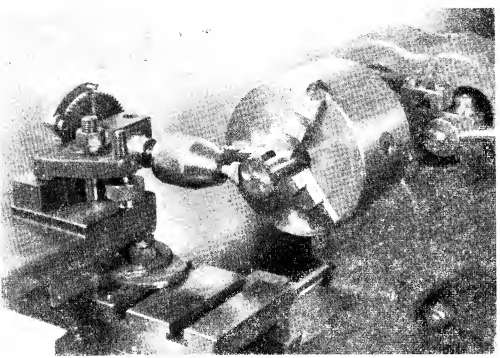
To withstand end thrust on the chuck spindle,

It will be apparent that one can quite easily machine "blind" hexagons—in other words, those with a solid round collar or "washer" formed below the head—in this way. The fact that the shoulders of the hexagon are left slightly concave, depending on the radius of the cutter used, is hardly perceptible if the spindle is at the correct height so as to produce a symmetrical cut. An important point when straddle milling with

two cutters is that the work should be properly centred between them, and the best way to ensure this is, when turning the head, to leave a "pilot" on the end of the same diameter as the finished size across flats ; this is easily located to pass between the two cutters with equal clearance, and ensures a properly balanced cut. The pilot-piece can easily be turned away after forming the head, and when a number of similar bolts have to be formed, it is only necessary to provide one of them with a pilot for initial setting. For screw slotting, a small "pip" may be left in the centre of the head to assist in locating the cutter—as a matter of fact, the "pip" is usually there whether it is wanted or not, in screws machined and parted off in the usual way.

ways, but anything in the nature of complication is best avoided if it involves a risk of impairing its ease of application. A better form of chuck would be a logical improvement, especially as the milling of polygons imposes more strain on the work than the slotting of screws. If screwed bushings are used to hold the screws, they should be of thin section, and slotted so as to be compressible when the chuck is tightened up. Cut the slots obliquely or spirally to avoid the risk of the slot coming in line with a chuck jaw and forcing the work out of truth.

For dealing with work of greater length than can normally be accommodated in the depth of the chuck jaws, it may be desirable to provide a hollow spindle. The thrust-pad of the simple



The fixture in use, slotting a large screw-head

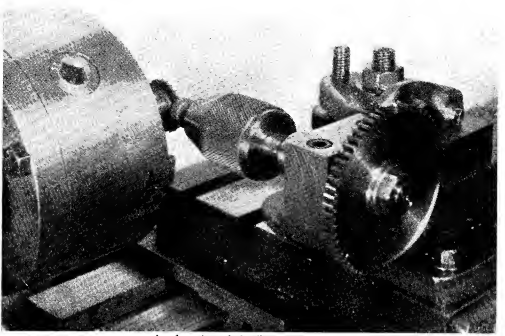
The fixture can be brought into action very quickly, as it is only necessary to substitute it for the turning tool in the lathe tool-post, and put the cutter arbor in the chuck—no more than a few seconds' work. Actual machining is in most cases equally expeditious ; it will, of course, be appreciated that the main utility of the device is for dealing with light, "fiddly" jobs, such as bolts from about $\frac{1}{8}$-in. or 4-B.A. downwards, or slotted screws from $\frac{1}{4}$-in. downwards. Such work is often extremely difficult to handle in other ways, even when a fairly extensive equipment is available.

Possible Improvements

It is quite obvious that this simple device is capable of considerable improvement in many

screwed chuck generally has a solid centre, but is capable of being drilled out to allow the work to pass through it. When projection of the work well beyond the chuck jaws is inevitable, some form of steady or back centre support is indicated ; it was intended to fit something of this nature to the device illustrated, but so far the necessity for it has never yet arisen. A suitable form of support very easily fitted to or removed from the appliance, is illustrated in Fig. 2.

When it is desired to use the device for fluting small taps or reamers, the centre height position is not suitable, unless specially formed end-mills, which are not very efficient for this purpose, are employed. The best way to get over this difficulty is to mount the entire assembly on the vertical slide, which thus provides facility for



Another view of the fixture in use

height adjustment. With the end support in use, it is not beyond the capability of the device to use it for cutting small gears and pinions. If a greater range of indexing is called for, a worm dividing-gear may be added—but here, perhaps there is a danger of straying far beyond the bounds of the simple function for which the device was intended.

Twin Sisters

(*Continued from page* 84)

quite a few enthusiasts who are able to " borrow " the use of this apparatus from friendly garage folk in their own vicinity.

The final stages will be found in the agonies of painting, lining and lettering and, much as I hate saying it, a very large number of locomotives are still writhing in acute discomfort at various exhibitions under the heavy coating of tar from which the usual small stones and gravel have not been strained. To see such jobs later put in steam is, if anything, even more awful, and the sight of huge, heaving bubbles, smoke and smells rising from the dicomfited smokebox of a job that otherwise is quite praiseworthy, is not only painful to the owner, but a discredit to the movement.

I say " discredit " because it is quite unnecessary. The modern synthetic finishes, applied with sufficient care to a correctly-prepared surface provide excellent results. The blobs and runs, the sticky and furry surfaces tell the tale of insufficient care and unsuitable surroundings during the vital operations, all of which quite easily may be avoided.

It appears to be a common belief that nothing on a locomotive should be painted until it is entirely finished. The reluctant builder then dismantles it only to find that certain parts have been riveted together, wheels have been driven on and other bits rather finally soldered up. His only course is then to peer round corners whilst wielding a piece of wood to which adheres a number of hairs that once all pointed in one direction, but have, of late, decided that independent action is the order of the day and dispersal is the only safe course. Where everything is to be painted black or green or some other colour, all is well—and inevitable, and follows closely on the belief that painting consists of daubing everything in sight, later rubbing it off where not required. I hope to dispel these queer and amusing ideas.

Any emphasis on finish, lining and lettering is not part of a grand finale to be dreaded and avoided, but rather a problem of correct materials and a thorough and careful approach to the subject. With this aspect firmly in mind, only a number of chapters carefully devoted can pave the way to a job that will give good appearance and wearing qualities that are far in advance of any of the painting methods I have yet been privileged to try ; and, with that knowledge secured, we will await the paint shop days with perfect equanimity.

(*To be continued*)